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Rural Non-farm Income and Inequality in Nigeria

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ABSTRACT

This paper investigates the contribution of rural non-farm income to income inequality by examining the contribution of specific income sources (farm income from irrigated agriculture, farm income from rainfed agriculture and non-farm income) to income inequality in Nigeria. The results reveal the relative importance of specific income sources to income inequality and the various determinants of income inequality in rural Nigeria. Although non-farm income is distributed more unequally than incomes from the other two sources, it contributes least to overall income inequality. Farm income from irrigated agriculture represents the most important inequality-increasing source of income.

Keywords: Non-farm income, inequality, Nigeria

1. INTRODUCTION

These days, it is very rare to find farmers in developing countries collecting all their income from any one source. Furthermore, rural people in developing countries are not equally committed to agriculture. Households may derive their incomes from a diverse portfolio of activities, including work in the rural non-farm sector (Adams 1999; Ellis 1998; 2000). According to several analysts (Mortimore 1989; Mortimore and Adams 1999; Adato and Meinzen-Dick 2002), careful examination of life in an African village reveals a broad range of livelihood activities that are essential to the livelihood security of rural populations in the developing world. It is generally believed that non-farm income activities play an enormous role in breaking the vicious cycle of poverty, because non-farm income can significantly increase the total income of rural dwellers, help smooth out income fluctuations, and improve food security through savings, which in turn allows rural dwellers to survive sudden shocks (see, for instance, Janvry et al. 2005; Ellis 1998; 1999; 2000). Some analysts have argued that non-farm income sources may already account for as much as 40-45 percent of the average rural household income in many developing countries (see, for instance, Reardon 1997; Barrett et al. *200*1).

The term 'poverty' is sometimes used interchangeably with the terms 'inequality' and 'welfare.' This has brought about conceptual confusion, as some analysts tend to equate poverty with inequality. Although these concepts are closely related, they have different meanings. Poverty is a narrower concept that strictly includes a censored distribution of individuals or households below an appropriate threshold level (*i.e.,* a poverty line). In contrast, inequality is defined over the whole distribution of a given indicator in a population[1]. Welfare also captures the whole distribution of a given indicator, but it differs from inequality in that the latter is independent of the mean of the distribution and instead is solely concerned with its dispersion (Litchfield 1999; McKay 2002; Naschold 2002).

Inequality is of concern to the international development community for many reasons. First, inequality is important to both poverty and growth. Increased inequality for a given level of an average welfare indicator (*e.g*., income) will almost always be associated with higher levels of poverty, because a smaller share of income will be obtained by those at the bottom of the income distribution (McKay 2002). This is particularly true for developing countries, where a highly unequal income distribution is almost always accompanied by high levels of poverty incidence (Ellis 2000). The redistribution of income can catalyze policies aimed at poverty reduction and growth acceleration. Hence, a triangular relationship exists among inequality, growth and poverty (Bourguignon 2004).

Inequality is the dispersion of a distribution of welfare indicators or attributes such as income or consumption. McKay (2002) defines inequality as a pattern of variation in well-being among people (or groups of people), visualized through indicators such as income, consumption, education, malnutrition, etc. Ray (1998:170) defines economic inequality as "the fundamental disparity that permits one individual certain material choices, while denying another individual those very same choices." These definitions articulate the multidimensionality of inequality.

Income inequality is more prominent in the literature compared to other dimensions of inequality. Income measurement does not seek to measure the inequality of an individual or generate a descriptive number, but rather makes comparisons between people or over time periods. Income is difficult to measure in rural societies due to annual income instability, seasonality associated with inherent risk fluctuations, recall problems, and other issues (Glewwe and Van Der Gaag 1990; Lipton and Ravallion 1995; Dercon 2005)[2].

It is vital to acknowledge and combine the diverse livelihood strategies and income portfolios of rural people when measuring poverty and inequality. In the present study, we examine whether rural non-

[1] This threshold may be set in absolute terms or in relative terms. Relative poverty is intimately connected to inequality because poverty manifests current living situations across the entire population.

[2] Income understatement may arise from a number of underlying causes, including recall problems (as people tend to forget their income portfolios), reluctance to reveal the total extent of income, and reluctance to admit to illegally obtaining income (Ravallion, 1998).

farm income increases or decreases income inequality. This is achieved by disentangling the inequality contributions of three different income sources (farm income from irrigation, farm income from rainfed agriculture, and non-farm income). This is particularly important because the results of the few available studies that have examined the contribution of different income sources to income inequality are varied. For instance, Kimmage (1991) finds that income from irrigation increases income inequality, since it primarily benefits the already wealthy farmers. Hussain and Hanjra (2004) show that income from rainfed farming increases income inequality more than income from irrigated settings. Huang et al. (2005) provide empirical evidence showing that income from irrigated agriculture will bring about reductions in income inequality, and Van Den Berg and Ruben (2006) conclude that income from irrigated agriculture will increase inequality if irrigated land is allocated to those households that are already well endowed with land. While these studies highlight the contribution of farm incomes to income inequality, the findings do not resolve the key question of the contribution of non-farm income to income inequality.

By paying particular attention to the contribution of non-farm income to income inequality, we herein examine the relative importance of specific income sources to income inequality in rural Nigeria. The next section describes the data and the survey area. Section 3 describes the utilized methodologies. Section 4 estimates the contribution of specific income sources to income inequality. Section 5 concludes.

2. BACKGROUND INFORMATION, DATA AND SURVEY AREA

The utilized data were collected from five different villages surveyed in rural Northern Nigeria between 2004 and 2005. These villages are situated within the Hadejia-Nguru floodplain wetlands of Jigawa state in Northern Nigeria. Data were collected from 200 households selected using a multi-stage stratified random sampling approach.

The first sampling stratum was selection of the dry savanna region of northern Nigeria, which comprises six states: Sokoto, Kebbi, Zamfara, Kano, Kaduna and Jigawa. The second stratum was the selection of Jigawa state. Two important elements informed this choice. First, Jigawa state, which was carved out of Kano state in August 1991, has the highest rural population in Nigeria; about 93 percent of the state's population dwells in rural areas[3]. Second, agriculture is the dominant sector of the state's economy, providing employment for over 90 percent of the active labor force. For effective grassroots coverage of the various agricultural activities in Jigawa state, the Jigawa Agricultural and Rural Development (JARDA) is divided into four operational zones that are headquartered in the cities of Birni Kudu, Gumel, Hadejia and Kazaure. Hadejia was selected for this study, forming the third stratum of sampling. Within the Hadejia emirate, there are eight Local Government Areas (LGAs): Auyo, Birniwa, Hadejia, Kaffin-Hausa, Mallam Madori, Kaugama, Kirikasamma and Guri. Kirikasamma LGA was selected for this study, representing the fourth sampling stratum. Kirikassama LGA was specifically chosen because of the area's intensive economic development and correspondingly higher human population compared to many other parts of Nigeria. In the fifth stratum of sampling, five villages were selected from Kirikassama LGA: Jiyan, Likori, Matarar Galadima, Turabu and Madachi. These villages were carefully selected to ensure that they were representative of other villages in the same general location. The selected villages differ in their ease of access to the main city in the area (Hadejia).

Jigawa state's climate is distinctly divided into rainy (June-September) and dry (October-May) seasons. Estimates indicate that 1.6 million hectares of farmland, representing about 70 percent of the total land mass of Jigawa state, are cultivable during the rainy season, while only about 79,000 hectares are cultivable during the dry season (Essiet and Yusuf 2000). Jigawa state is dominated by vast floodplains, which are popularly referred to as *fadama* lands. These *fadama* lands are characterized by the ready availability of both open surface and underground water. The surveyed villages have a largely unimodal distribution of rainfall (April/May through September/October). However, periodic droughts and high variations in annual rainfall totals are common throughout the villages' histories (Milligan 2002; Mortimore 2000).

Land ownership and land tenure are very important in the surveyed villages, where land yields direct economic benefits as a key input into agricultural production, as a source of income from rental or sale, and as collateral for credit that can be used for consumption or household investments. Two types of farmland can be clearly differentiated in the survey villages: the rainfed uplands (locally called *gona* or *tudu*), which are usually cultivated during the rainy season, and the lowland fields (*fadama*), which are referred to as irrigable land and are usually cultivated during the dry season. Among the survey respondents, farmland is commonly fragmented (not contiguous), comprising both upland and *fadama* land. Although this provides some equitability in the distribution of land of varying soil types and may reduce the effect of rainfall variation (particularly at the beginning and end of the rainy season), the fragmentation of farm plots makes it difficult for an individual farmer to develop a large area using certain technologies, and means that farmers spend time walking from their residences to the different fields.

Different crops are cultivated on the two types of farmland. The crops commonly grown in the uplands during the rainy season include sorghum, millet, cowpea, beans, groundnut, rice, maize, sesame and okra. The crops grown during the dry season through *fadama* farming have changed a great deal over

[3] By comparison, the rural populations in other states of Nigeria comprise 6 percent of the total population in Lagos, 31 percent in Oyo, 38 percent in Anambra, 88 percent in Kebbi, and 86 percent in Sokoto (NPC, 2004).

time. When *fadama* farming first started, it consisted of small-scale cultivation of cereals, such as barley, rice or guinea-corn. In the 1970s, there was significant interest in sugarcane, which is still grown in some areas. However, since the 1980s, wheat and vegetables (e.g., carrots, peppers, tomatoes, onions and various other leafy vegetables) have come to be the most important irrigated crops cultivated in the surveyed villages.

Within the villages, households were selected and information was collected on farm and non-farm income levels and sources of income. The income values were collected in a comparable way across households. Among respondents, the average age was 48.5 years and the average household size was 12.5 individuals. Table 1 presents information on the basic characteristics of the respondents.

Table 1. Basic Characteristics of Respondents

Basic Characteristic	Frequency of Households
Number of respondents of ages 21-30	2
Number of respondents of ages 31-40	30
Number of respondents of ages 41-50	98
Number of respondents of ages 51-60	48
Number of respondents above age 60	22
Total number of respondents	200
Number of respondents with household size 1-10	83
Number of respondents with household size 11 and above	117
Number of respondents with no form of education	69
Number of respondents with primary education	33
Number of respondents with secondary education	7
Number of respondents with secondary education	4
Number of respondents with Quranic form of education	87

Although our rationale for dividing respondents' incomes into three sources should be apparent, our reasons for distinguishing between irrigated and rainfed farm incomes should perhaps be clarified. Arguably, within a rural economy it is artificial and empirically difficult to distinguish between farm income from irrigation and farm income from rainfed agriculture, since the main inputs used to generate outputs from both practices of agriculture are similar. However, the two types of farmland can be clearly differentiated within the study area, making it both possible and important to differentiate between the two income sources. *Fadama* irrigation is almost as important as rainy season upland cultivation when considering income-earning activities in the survey villages. The irrigation technologies used for *fadama* farming in the survey villages are rarely utilized for rainfed upland farming.

In the present study, income is disaggregated between farm and non-farm income as described by Ellis (2000:11), who states that "farm income refers to income generated from own-account farming, whether on owner-occupied land, or on land accessed through cash or share tenancy. Farm income, broadly defined, includes livestock as well as crop income, and comprises both consumption-in-kind of own-farm output as well as the cash income obtained from output sold," while "[n]on-farm income refers to non-agricultural income sources." Ellis's justification for separating farm and non-farm income is based on the fact that rural people in developing countries maintain a portfolio of activities that are sustained through their livelihood capabilities and resources.

Here, we divide the respondents' estimated total annual incomes among three sources of income: farm income from *fadama* irrigated farming, farm income from rainfed uplands, and non-farm income. Income from both *fadama*-irrigated farming and rainfed upland farming includes incomes from the sale of all crop outputs (including grains, vegetables and fruits), the imputed value of all crop outputs retained for consumption, and the imputed value of crop byproducts. The incomes are estimated net of all cash expenditures on material inputs (seeds, fertilizers, chemicals), hired labor, and irrigation technologies (*e.g.*, water pumps and drilling of tubewells). Non-farm income herein refers to non-agricultural income sources, as defined by Ellis (2000), Adams (1999), Janvry et al. (2005) and Barrett et al. (2001); these include estimated incomes from fisheries, informal petty trading, rural food processing, home gardens, livestock production and labor exchanges among family members and neighbors.

Despite the challenges that weaken the usefulness of income data (e.g., annual income instability, seasonality due to inherent risk fluctuations, recall problems, etc.), the present study utilizes income data for two important reasons[4]. First, we use income data rather than consumption data because consumption data are more difficult to collect in the absence of a proper monitoring system and pre-existing baseline information. Second, the use of income data helps us identify the various occupational sources of the respondents' incomes from among their diverse livelihood activities, and allows us to distinguish among incomes attributable to irrigated agriculture, rainfed farming, and other sources of income.

Notably, it is particularly difficult to estimate incomes among farmers in developing countries due to problem of seasonality recall, tendency to underestimate their incomes, and apparent lack of record keeping. Indeed, similar issues have prevented some researchers from collecting data concerning income or consumption (see, for instance, Udry 1991). It is true that both income receipt and consumption expenditure are continuous processes that are unlikely to be recovered reliably with a one-month recall. However, such issues are common to most studies that rely on single-visit interviews of non-literate rural residents, who rarely keep records and may be unfamiliar with standard measures. Furthermore, in the case of the data used for this study, the interviewers spent considerable time with the respondents over a full 12 months. Due to the level of trust established during this period, it was possible for the interviewers to conduct a relatively accurate comparative analysis of the respondents' farm and non-farm budgets. Furthermore, semi-structured focus group discussions were conducted prior to data collection, and the use of structured questionnaires provided an overall picture of the respondents' income sources and the amount of income generated annually from their main livelihood activities. Nevertheless, although we feel that the collected data are relatively representative of the real-world situation, the income portfolios reported herein should be seen as indicative rather than definitive.

As defined herein, the combination of farm income from irrigated agriculture and farm income from rainfed agriculture is equal to total farm income, and the combination of total farm income and non-farm income is equal to total income.

[4] Consumption is a better indicator of current and long-term welfare if consumption smoothing is practiced and consumption is more related to well-being than income (see, for instance, Ravallion, 1992; Carvalho and White, 1997; Ellis, 2000).

3. METHODOLOGY

Inequality Measurement

When measuring income inequality, it is critical to choose an inequality measure that meets certain criteria or general guidelines for the desired application. These criteria are not only important for helping eliminate measures that are "unsuitable" for a particular case, they also help put personal preference into perspective when choosing an inequality measure (Cowell 1995). Furthermore, to choose the result of an inequality measure, one needs to understand the underlying criteria for using such measure. The criteria may also serve as elementary properties from which new inequality measures can be built.

Criteria for Inequality Measures

Following distinguished scholars such as Atkinson (1970), Cowell (1995) and Ray (1998), the criteria or "set of axioms" that an inequality measure should satisfy are as follows:

Anonymity. In short, the names of the income-earners in a distribution do not matter. If person A earns more income than person B, an inequality measure should treat the situation as identical to one in which person B earns more income than person A. Permutation of incomes among individuals should not affect inequality judgments.

Population Principle. If we clone or replicate the entire population (and the associated incomes) in the same proportion, then inequality should not change. Cowell (1995) and Ray (1998) illustrate this by comparing income distributions over *n* and *2n* people with the same income patterns repeated twice in the same proportion. Inequality is found to be the same in the two corresponding populations. In other words, inequality measures should be insensitive to the population size in a distribution; instead, it should be sensitive to the population shares or the proportions of the population that receive different amounts of income.

Relative Income Principle. This criterion is similar to the population principle except that it deals with income. In short, changing the income level of every member of a population proportionally or uniformly should not affect inequality. The relative income principle indicates that the absolute income received by each individual does not matter; instead, the measure should examine income shares in the form of population percentages. In this sense, it is common to divide a population into particular quantile groups, such as fifths (quintiles) or tenths (deciles), and portray their different income shares for measurement of income inequality within the population.

Principle of Transfer. This criterion states that if one distribution can be achieved from another by constructing a sequence of regressive transfers, then the former distribution must be deemed more unequal than the latter. The essence of the principle is that our desired inequality measure should reflect that a small transfer of income from a richer person to a poorer person will reduce inequality (or at least not raise inequality) and vice-versa.

Decomposability. This means that the inequality measure can be broken down into components or constituents such as sub-groups of a population in an income distribution (for example between and within industrial labor, or urban versus rural areas). If inequality rises in each of the sub-groups, the overall inequality will also increase and vice-versa. Inequality decomposition is a standard property for an inequality measure because it tends to reveal the contribution of different sub-groups to inequality. Inequality decomposition can be subdivided into two components: static decomposition (decomposition in any one year) and dynamic decomposition (decomposition of changes in inequality over time)[5]. Different inequality measures place relative weights on different parts of the income distribution. Thus, an inequality measure assigns a value to the income distribution in a manner that reflects the inequality of that distribution. A higher value of the measure tends to indicate higher inequality, while a lower value tends to indicate lower inequality.

Description of Inequality Measures

Based on the writings of Ray (1998), Cowell (1995) and Litchfield (1999) on the many inequality measures that have been proposed in the literature, brief discussions of inequality measures from the simplest measures of variation or dispersion to the standard techniques utilized today are provided as follows.

The Normalized Range. The normalized range, R, is computed as the difference between the richest (Max.y) and poorest (Min.y) people in the income distribution, divided by the mean (μ) in order to ignore the units of measurement of our indicator. Thus defined, R is given by:

$$R = (\text{Max.y} - \text{Min.y})/\mu \qquad (1)$$

[5] See Deaton (1997) for further elaboration.

R is very easy to compute and tends to be useful in the absence of complete information on the distribution of income. If income is divided absolutely equally, then R = *0*. If one individual earns all of the income, then R = the number of persons (n) in the income distribution. Therefore, the value of R always lies between *0* and n. Since R makes use of only the highest and lowest values, it completely ignores the values or individuals between the top and bottom of the scale and is not a good measure when the highest and lowest values are at the extremes. It satisfies the criteria of anonymity, population and relative income principles for measuring inequality, but does not meet the criteria of decomposability and principle of transfer.

Kuznets Ratios or Share Ratios. The approach, which involves simply dividing the share of the richest by that of the poorest, measures the degree of inequality between the two extremes. The share approach is a common measure of inequality that features prominently in the literature. However, it is not a good measure of inequality, as it tends to ignore the individuals in the middle of the income scale, and hence does not obey the transfer principle. It only provides an informal indication of inequality, and tends to be used in situations where detailed information on income is not available. Although it satisfies the criteria of anonymity, population and relative income principles, it is not decomposable.

Mean Absolute Deviation. This measure of inequality has the advantage of involving the entire income distribution. It is calculated as the summation of the absolute difference between the mean and each data point on the income scale, divided by the total income, as follows:

$$M = \frac{1}{\mu n}\sum_{i=j}^{m} n_j \left| y_j - \mu \right| \qquad (2)$$

With perfect equality, $M = 0$, and with one person earning all income, $M = 2(n-1)/n$. The disadvantage of this measure is that it does not obey the transfer principle and is not decomposable. It also tends to violate the relative income principle because it increases with the relative level of income, meaning that richer countries or people will usually be more unequal than poorer ones. Therefore, this measure only satisfies the anonymity and population principles for inequality measurement.

Coefficient of Variation.[6] The coefficient of variation is calculated as the ratio of the standard deviation (or the square root of the variance) and the mean income (μ), indicating that what matters is relative inequality, as shown by:

$$C = 1/\mu \sqrt{1/n \sum_{i=1}^{n} (y_i - \mu)\hat{}2} \qquad (3)$$

This measure also makes use of the entire income distribution. It is a useful statistic that tends to correct the weakness of the mean absolute deviation by satisfying the first four criteria for measuring inequality, including the transfer principle. However, similar to the other measures reviewed so far, it is not decomposable. In addition, it has the disadvantage of focusing between the top and middle of the income distribution.

[6] Variance (i.e., the square root) is also used as an inequality measure. However, it violates the relative income principle for measuring inequality by quadrupling the estimate of income inequality when all incomes are doubled. Variance of logarithms and logarithmic variance are two other related inequality measures, but they fail the criteria of decomposability and the principle of transfer (see Cowell, 1995).

Theil Coefficients. Cowell (1995) argues that any measure of inequality that satisfies all five criteria for measuring inequality (including the attractive property of being easily decomposable by subgroups) should be classified as a member of the Generalized Entropy (GE) class of inequality measures. Inequality measures of the GE class are all decomposable into intuitively appealingly components of within- and between-group inequality. The general formula of members of the GE class of measures is:

$$GE(\propto) = \frac{1}{\propto^2 - \propto}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\mu}\right)^{\alpha} - 1\right] \tag{4}$$

Where n is the number of individuals in the sample, y_i is the income variable of individual i (1, 2...n), and μ is sample mean of the income variable. The value of GE ranges from 0 to ∞, with the former representing an equal distribution or perfect equality (all income variables identical) and higher values indicating greater inequality. The parameter α represents the weight given to the distances between income variables at different parts of the income distribution, and can take any real value. For lower values of α, GE is more sensitive to low-end inequality changes; for higher values, GE is more sensitive to upper-end inequality changes. The most common values of α are 0, 1 and 2.

Theil coefficients, which appear to satisfy all the criteria for measuring inequality, can easily be derived from (4). Plugging α values of 0 and 1 into equation (4) produces the two popular Theil measures of inequality: the mean log deviation (or Theil L) and the Theil index (or Theil T), respectively. These are represented mathematically as follows:

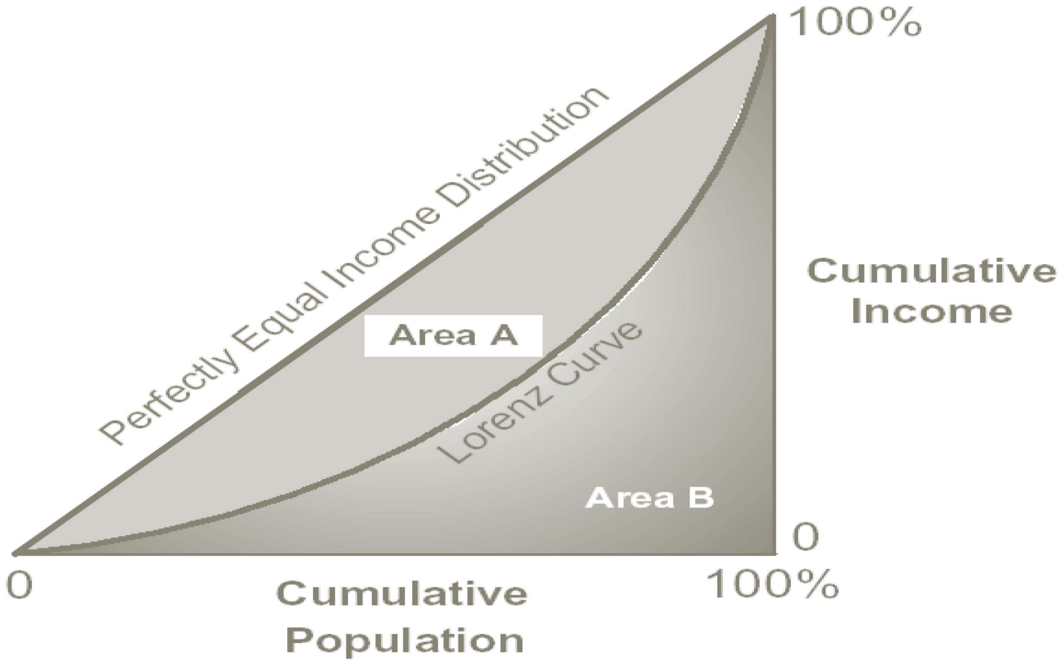
$$GE\ (0) = \text{Theil L} = \frac{1}{n}\sum_{i=1}^{n}\log\frac{\mu}{y_i} \tag{5}$$

$$GE\ (1) = \text{Theil T} = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{\mu}\log\frac{y_i}{\mu} \tag{6}$$

The Theil L index is most sensitive to low-end inequality changes. A zero value of the measure indicates perfect equality, while higher values indicate greater inequality. Theil L gives more weight to distances between the bottom members of the income distribution, while Theil T gives equal weights across the distribution. This means that if we are interested in inequality among the poorest, we should use Theil L. If, however, we are interested in measuring inequality in a perfectly equal society, Theil T might suffice, since it is based on computing the ratio of income share to population share. The two measures have the unique advantage of being easily decomposed, due to the additive property of logarithms. This makes them mathematically elegant measures of inequality. Furthermore, Theil indices may be decomposed by region, religion, ethnicity, economic activity, etc. The addition of both within- and between-group components still sums up to the total inequality when using these measures. To make this decomposition work when aggregating the Theil indices across sub-groups, it is necessary to take a weighted average, using population and income shares as the weights for Theil L and Theil T, respectively. Finally, the Theil indices can be computed from any type of grouped data, even if incomes overlap within the groups.

Gini Coefficients and Lorenz Curves. The Gini coefficient, which incorporates more detailed share data, captures inequality starting from the base and moving across the entire distribution. It satisfies almost all of the criteria for measuring inequality, and has attractive properties that can inform policy analysis. Other advantages of the Gini coefficient include its clarity and its ability to offer an easily interpretable picture of inequality, largely because the Gini coefficient can easily be derived from the Lorenz curve. The Lorenz curve is a theoretical cumulative distribution curve of income-to-population, in which the individuals in a population are ranked from the poorest to the richest. Figure 1 illustrates a Lorenz curve showing the degree of inequality in an income distribution. If incomes are completely equal, each cumulative percent of population yields a directly proportional percentage of income, and the Lorenz curve lies on a straight 45 degree line; this is called "perfect equality." As inequality increases, the Lorenz curve moves further away from the perfect equality line and "Area A" increases. The Gini coefficient is easily derived from the Lorenz curve as: (Area A)/(Area A + Area B) or (Area A)/(Total Area). This also means that the larger the share of Area A, the higher the Gini coefficient. The Gini coefficient takes values ranging from 0 (perfect equality) to 1 (100% or perfect inequality).

Figure 1. Illustration of the Lorenz Curve and Gini Coefficient



A key disadvantage of the Gini coefficient is that it seems to be more responsive to changes in distribution among the middle classes and is not as sensitive at the extremes. This insensitivity is greatest in relation to the total income of the poorest. Furthermore, two populations can have similar average incomes and Gini coefficients while having different income distributions that allow their Lorenz curves to intersect or cross. Nevertheless, the Gini coefficient is probably the most widely quoted measure of inequality.

Since we herein focus on identifying the extent to which specific income sources contribute to overall income inequality, we utilize the Gini coefficient to reveal the contribution of each individual income source to overall income inequality (see, for instance, Adams 2001; McKay 2002; and Huang et al. 2005). Equation (7) presents the formula we herein use to derive the Gini coefficient:

$$Gini = \frac{1}{2n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} n_i n_j |y_i y_j| \qquad (7)$$

Examining Income Inequality by Income Source

Following the approaches employed by Adams (1999), Adams (2001) and Huang et al. (2005) and using the Gini coefficient, we clarify the contribution of each income source of farmers in rural Nigeria to their respective overall income inequality, as explained below.

Assuming that *yk* represents the income (*y*) from source *k* (for instance, non-farm income), the total income for a particular individual or household, *yo* can be written as:

$$y_0 = \sum_{k=1}^{K} y_k, \quad k = 1, \ldots, K. \tag{8}$$

Using the method proposed by Stuart (1954), Pyatt et al. (1980), Lerman and Yitzhaki (1985), and employed by Stark et al. (1986), Adams (1999) and Huang et al. (2005), the Gini coefficient for total income, *G* can be denoted as:

$$G = \sum_{k=1}^{K} R_k G_k S_k \tag{9}$$

where *Rk Gk Sk* is the contribution of income source *k* to overall income inequality; *Sk* represents the share of income from source *k* in total income; *Gk* represents the Gini coefficient of the inequality in the distribution of income source *k* (i.e., the Gini coefficient of *yk*); and *Rk* stands for the Gini correlation between income from source *k* and total income. According to Adams (1999) and Huang et al. (2005), *Rk* can be calculated as follows:

$$R_k = \mathrm{cov}(y_k, F(y_0))/\mathrm{cov}(y_k, F(y_k)) \tag{10}$$

where *F(yo)* and *F(yk)* represent the cumulative distributions of the total income and the income from source *k*, respectively. It then applies that the contribution of each individual income source *k* to the overall income inequality can be decomposed into three components. As shown in equation (9), the first component is the share of income from source *k* in total income. The second component is the Gini coefficient of the inequality in the income distribution of income source *k*. The third component is the correlation between income source *k* and the overall income. The smaller the product of these three components multiplied together, the lower the contribution of income from source *k* to total income inequality, and vice-versa.

Notably, the value of *Sk* is always positive and less than 1; the value of *Gk* is always positive and may be greater than 1 when the values for of one or more of the income sources are negative; and the value of *Rk* is always between -1 and +1. *Rk* shows the strength of the relationship between the income sources and the total income, and reflects the degree to which they are related. When *Rk* = +1, there is a perfect positive relationship between income source and total income. When *Rk* is less than 0, the income source is negatively correlated with the overall income.

Adams (1999) further illustrates how to detect whether an income source decreases or increases the overall income inequality based on the share of that income source, by re-writing equation (9) as follows:

$$g_k = R_K \frac{G_K}{G} \tag{11}$$

where g_k represents the relative concentration coefficient of income source *k* in the total income inequality. Whether g_k is greater or less than 1 shows whether income source *k* respectively increases or decreases the overall income inequality.

4. RESULTS

Income Portfolios of Respondents

The importance of isolating farm income attributed to non-farm activities from other sources of income can easily be observed in the results shown in Table 2. There are considerable differences in the 2004-2005 income portfolios of the respondents. Farm income sources are the biggest contributors to overall income; however non-farm income activities contribute approximately 21.9 percent of the estimated total annual income.

Table 2. Average Income Portfolios of Respondents

Incomes	Mean values for sample (in Naira)	Shares of total income (%)
Total income	167,698	
Farm income from irrigated agriculture	70,375	42.0
Farm income from rainfed farming	60,536	36.1
Total farm income	130,911	78.1
Non-farm income	36,788	21.9

Further disaggregation of the respondents' average income portfolios by income quintile groups (five different equal-sized groups) in order of poorest (or lowest income) to richest (highest income) helps clarify the relative contribution of the income sources to the total incomes of respondents belonging to different quintiles. As presented in Table 3, these results reveal major differences in the income sources of the poorest and the richest respondents (i.e., the extremes of the distribution). This finding becomes very glaring when we use the share approach (dividing the share of the richest quintile to that of the poorest quintile), which measures the degree of disparity between two extremes of very poor and very rich.

Table 3. Average Income Portfolios of Respondents Disaggregated by Quintile Group

Incomes (mean values for sample; in Naira)				
	Total income	Farm income from irrigated agriculture	Farm income from rainfed farming	Non-farm income
Lowest	35,023 (4.2)	13,924 (4.2)	9,620 (3.2)	1,180 (0.6)
Second	64,545 (7.7)	25,294 (7.2)	22,833 (7.5)	11,932 (6.5)
Third	122,299 (14.6)	49,208 (14.0)	39,746 (13.1)	24,219 (13.2)
Fourth	182,949 (21.8)	77,650 (22.1)	60,100 (19.9)	37,395 (20.3)
Highest	433,675 (51.7)	185,798 (52.8)	170,380 (56.3)	109,213 (59.4)

Note: Shares of total income (%) are shown in parentheses.

We see that the richest quintile of respondents earned 12.3 times the total income earned by the poorest quintile. These fold-values are 12.6 and 17.6 when we consider farm incomes from irrigated agriculture and rainfed agriculture, respectively. As far as non-farm incomes are concerned, the richest quintile earned 99 times the amount of non-farm income earned by the poorest quintile, indicating that non-farm income is distributed more unequally than the other two income types in rural Nigeria.

Contributions of Specific Income Sources to Income Inequality

Based on the analytical framework presented in Sub-section 3.2, we next examine the contributions of the different income sources to income inequality. As shown in Table 4, the overall Gini coefficient (*G*) of the total income of respondents is 0.467. This result is comparable to the Gini coefficient of 0.428 that was derived for rural Nigeria using data collected in 1995 (see, for instance, Federal Office of Statistics 1999; Aigbokhan 2000). The results also fall within the range of Gini coefficients derived for other rural areas of developing countries, such as 0.532 for Egypt (Adams 2001) and 0.541 for rural China (Huang et al. *200*5).

Table 4. Contributions of Different Sources of Income to Overall Income Inequality

	Gini coefficient for income source G_k	Gini correlation with total income rankings R_k	Contribution of income source to overall income inequality S_k	Relative concentration coefficient of income source g_k	Percentage contribution to overall income inequality
Farm income from rainfed agriculture	0.474	0.977	0.167	0.992	35.8
Farm income from irrigated agriculture	0.450	0.995	0.188	0.959	40.3
Non-farm income	0.525	0.969	0.111	1.089	23.9
Total Income	G = 0.467				100.0

The overall Gini coefficient of 0.467 derived herein represents the expected difference in incomes of any two households randomly selected from the entire population. Since the mean value of total income in the study population is 167,698 Naira, the expected difference in incomes of the two randomly selected households is 46.7 percent of the mean income of 167,698 Naira, or 78,315 Naira. When considering farm income from rainfed agriculture, farm income from irrigated agriculture, and non-farm income, the corresponding values are 28,694 Naira, 31,669 Naira and 19,314 Naira, respectively. The decomposition of income inequality by income source shows that farm income from irrigated agriculture contributes most to overall income inequality. In percentage terms, the contribution of farm income from irrigated agriculture accounts for 40.3 percent of the overall income inequality among the respondents. The relatively uneven distribution of *fadama* irrigable land may be responsible for our finding that agricultural income from irrigated agriculture is the most important inequality-increasing source of income.

Interestingly, although non-farm income is distributed more unequally than the other sources of income (as reflected in its higher Gini coefficient), its contribution to overall income inequality is the smallest (23.9 percent). This is probably because non-farm income comprises the smallest share in total rural income among the respondents, and the Gini correlation of non-farm income with total income rankings is lower than that for the other income sources.

Because agricultural incomes from irrigated agriculture and rainfed agriculture contribute heavily to the overall income inequality of the respondents, these incomes might significantly increase the total income of respondents in the higher end of income distribution, while having a smaller impact on the total income of those at the lower end, thereby increasing overall total income inequality. Supporting this, we see in Table 4 that all three income sources are concentrated in the richest respondents and all of the Gini correlations between income sources and total incomes are very high among these respondents.

In sum, our findings suggest that participation in non-farm activities reduces income inequality among rural Nigerians, and further suggest that the absence of non-farm incomes would increase the Gini coefficient of the respondents' total incomes. These results are consistent with the findings of other researchers on the role of non-farm income on income inequality (see, for instance, Elbers and Lanjouw 2001; Reardon and Taylor 1996; and Janvry et al. 2005).

5. CONCLUSION

We herein analyze the contribution of different income sources to income inequality in rural Nigeria by dividing respondents' income portfolios among three income sources, namely farm income from irrigation, farm income from rainfed agriculture and non-farm income.

Three key conclusions emerge from our results. First, there are significant differences in the proportions of farm and non-farm activities in the income portfolios of rural people in rural Nigeria and perhaps throughout the developing world. The differences we observe in total farm income and non-farm income are quite significant, with 78.1 percent of total income arising from farm income (both irrigated agriculture and rainfed agriculture) and 21.9 percent coming from non-farm income. Second, disaggregating the average income portfolios by income quintile groups reveals that non-farm income is distributed more unequally than the other two sources of income in rural Nigeria. This is because the richest quintile of the respondents earned 99 times the amount of non-farm income earned by the poorest quintile in rural Nigeria. Third, examination of the contribution of each specific income source to income inequality shows that non-farm income effectively decreases income inequality in rural Nigeria.

The decomposition of income inequality by income source highlights the importance of knowing the contribution of different sources of income to income inequality. The contribution of non-farm income to overall income inequality is the smallest among the different sources of income. Without knowledge of the inequality decomposition, one might conclude that non-farm income increases income inequality, since it is the most unequally distributed (as reflected in its high Gini coefficient). However, our analysis shows that farm income from irrigated agriculture represents the most important inequality-increasing source of income in rural Nigeria, helping us identify non-farm income as a means to potentially *decrease* income inequality in rural Nigeria.

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